SEQUENCE SWITCHES
A AND B TYPES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers A- and B-type sequence switches.

1.02 This section is reissued to revise the information covering the methods of identifying springs equipped with No. 1 contact metal tips, to revise the List of Tools, Gauges, and Materials, to add the method of preparing the cleaning solution, and to revise the procedure covering cleaning of drive discs. Detailed reasons for reissue will be found at the end of the section.

1.03 Reference shall be made to Section 020-010-711 covering general requirements and definitions for additional information necessary for the proper application of the requirements listed herein.

1.04 ***One drop of oil*** for the purpose of this section is the amount of oil released from the nozzle of the 401A oil gun when the plunger is turned in (clockwise) from the point at which the spring pawl of the oil gun engages one notch to the point at which the pawl engages the next notch, or it is the amount of oil released from a piece of 22-gauge bare tinned copper wire after it has been dipped into oil to a depth of 1/4 inch and slowly removed.

1.05 ***One discharge of grease*** for the purpose of this section is the amount of Veedol All Purpose grease discharged from the 353C grease gun when the piston is fully depressed once.

1.06 ***Position 1 of 20-Position Sequence Switches Having No A Cams:*** The sequence switch is set in position 1 for the purpose of checking the B spring clearance when all other cams on the switch are within 0.024 inch of their theoretically correct location with respect to their associated springs, measured at the center lines of the springs.

1.07 ***Nonmetallic and Metallic Cam-Shaft Bearings:*** Cam-shaft bearings at each end of the sequence switch may be either metallic or later nonmetallic type. Nonmetallic bearings at the driven disc end are self-lubricating and shall not be lubricated. Metallic bearings at the driven disc end require lubrication and are identified by a red stripe on the associated bearing pin. A dark-colored composition tip on the bearing pin indicates the pin has a nonmetallic insert. In all cases, the tip of the bearing pin is lubricated when first installed. Subsequent lubrication depends on the kind of tip provided.

1.08 ***Cam cuttings*** are actually 1/4 position longer at each end than indicated by the cam-cutting designations, except cuttings designated in eighths such as 12-3/8, 13-1/8, etc. These are actually cut only 1/8 position longer at each end than indicated.

> ***Example:*** A cutting such as 12-1/2 to 13-1/2 actually extends from 12-1/4 to 13-3/4. A cutting designated 12-3/8 actually extends from 12-1/4 to 12-1/2.

1.09 A red diagonal stripe or red letter on the index tab of a contact spring assembly indicates that the associated cam is silver-surfaced.

1.10 A white stripe approximately 1/16 inch wide on the associated contact-spring-assembly index tab or mounting bracket indicates that one or more of the spring tips have No. 1 contact metal. If the index tab is at the front of the mounting bracket, the stripe extends across the tab directly below the letters on the tab. If the index tab is at the rear of the bracket, the stripe is located on the vertical surface at the front of the bracket directly above the contact spring assembly.

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2. REQUIREMENTS

2.01 *Cleaning*

(a) ***Scrubbing of Cams:*** Cams shall be scrubbed in the approved manner.

(b) ***Scouring and Scrubbing of Cams:*** Cams shall be scoured and then scrubbed in the approved manner.

(c) ***Recommended Intervals***

(1) All cams shall be scrubbed when necessary, as indicated by trouble data analysis. Cams may require scrubbing at yearly intervals.

(2) Pitted bronze cams shall be scoured and then scrubbed when necessary as indicated by trouble data analysis. Where intervals have been established locally for scouring and scrubbing of pitted bronze cams, these intervals may be extended when the associated springs are equipped with No. 1 contact metal tips.

(3) Talking cams (silver or bronze) shall be scoured and then scrubbed as required to maintain satisfactory transmission noise levels. Scouring and scrubbing of talking cams may require scouring at 2-to-5-year intervals and scrubbing at yearly intervals depending upon local conditions. Where the springs are equipped with No. 1 contact metal tips, scouring may not be required.

2.02 ***Operation of A Cam Roller:*** Fig. 1(A) — The A cam roller shall be free from bind and shall make a partial revolution at each high spot of the A cam.

Gauge by eye and by feel.

2.03 *Lubrication*

(a) ***Nonmetallic Bearing — Cam-Shaft Bearing — Driven Disc End:*** Fig. 5(A) — This bearing is a self-lubricating bearing and shall not be lubricated.

(b) ***Metallic Bearing — Cam-Shaft Bearing — Driven Disc End:*** Fig. 5(A) — This bearing shall be adequately lubricated with Veedol All Purpose grease. When lubrication is necessary, one discharge of grease shall be applied.

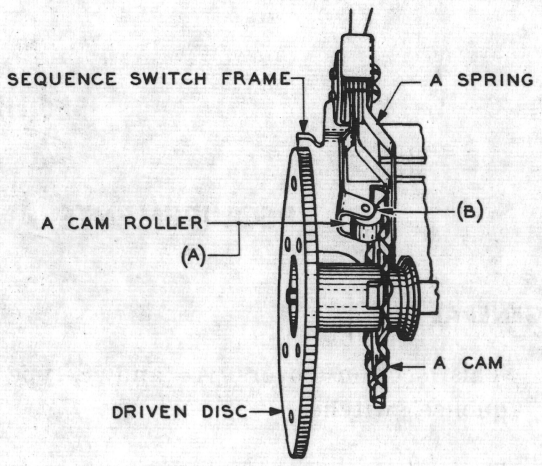

Fig. 1 – A Cam and Associated Parts

(c) ***Nonmetallic Bearing — Cam-Shaft Bearing — Index Wheel End:*** Fig. 2(A) — This bearing shall be lubricated with one discharge of Veedol All Purpose grease when first installed. Subsequently, whenever the bearing pin is disengaged from the cam shaft for other reasons, the bearing pin shall be examined for evidence of grease and, if no grease is evident, one discharge of grease shall be applied.

(d) ***Metallic Bearing — Cam-Shaft Bearing — Index Wheel End:*** Fig. 2(B) — This bearing shall be lubricated with Veedol All Purpose grease. When lubrication is necessary, one discharge of grease shall be applied.

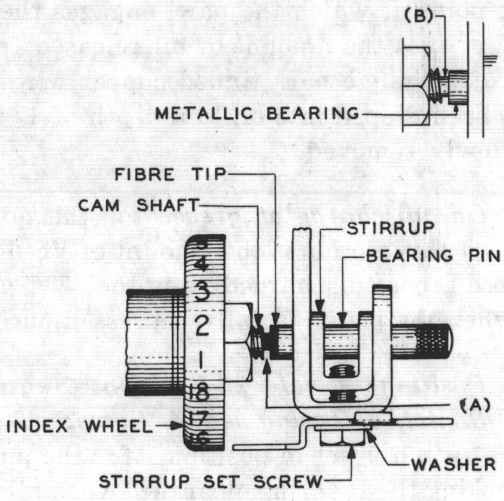

Fig. 2 – Nonmetallic-Type Bearing Pin

(e) ***A Cam Roller Bearing:*** Fig. 1(B) — This bearing shall be adequately lubricated with KS-16326 L1 oil. When lubrication is necessary, one drop of oil shall be applied. The convex surface of the roller and the A spring shall be kept free from oil.

(f) ***Recommended Lubrication Intervals:*** The recommended lubrication interval of metallic-type bearings at the driven disc end of the cam shaft shall be in accordance with the curve shown in Fig. 3. For example, where the sequence switch operates 100,000 revolutions per year, the interval is every 6 months. It is also recommended that the A cam-roller bearings be lubricated at intervals of 6 months. These intervals may be extended if periodic inspections have indicated that local conditions are such as to insure that requirements (b), (d), and (e) will be met during the extended interval.

2.04 ***Record of Lubrication:*** During the period of installation, a record shall be kept, by date, of the lubrication of the cam-shaft bearings and the A cam-roller bearings and this record shall be turned over to the telephone company with the equipment. If no lubrication has been done, the record shall so state.

2.05 ***Endplay of Cam Shaft:*** Fig. 2(A) and (B) — The sequence switch cam shaft shall have perceptible endplay in its bearings but this endplay shall be

Max 0.005 inch

Check the endplay of the cam shaft either by grasping the index wheel and attempting to move the cam shaft sidewise or by attempting to insert the 0.005-inch blade of the 66D gauge in the gap between the shoulder of the bearing pin and the end of the shaft with the play taken up toward the left. See Fig. 24.

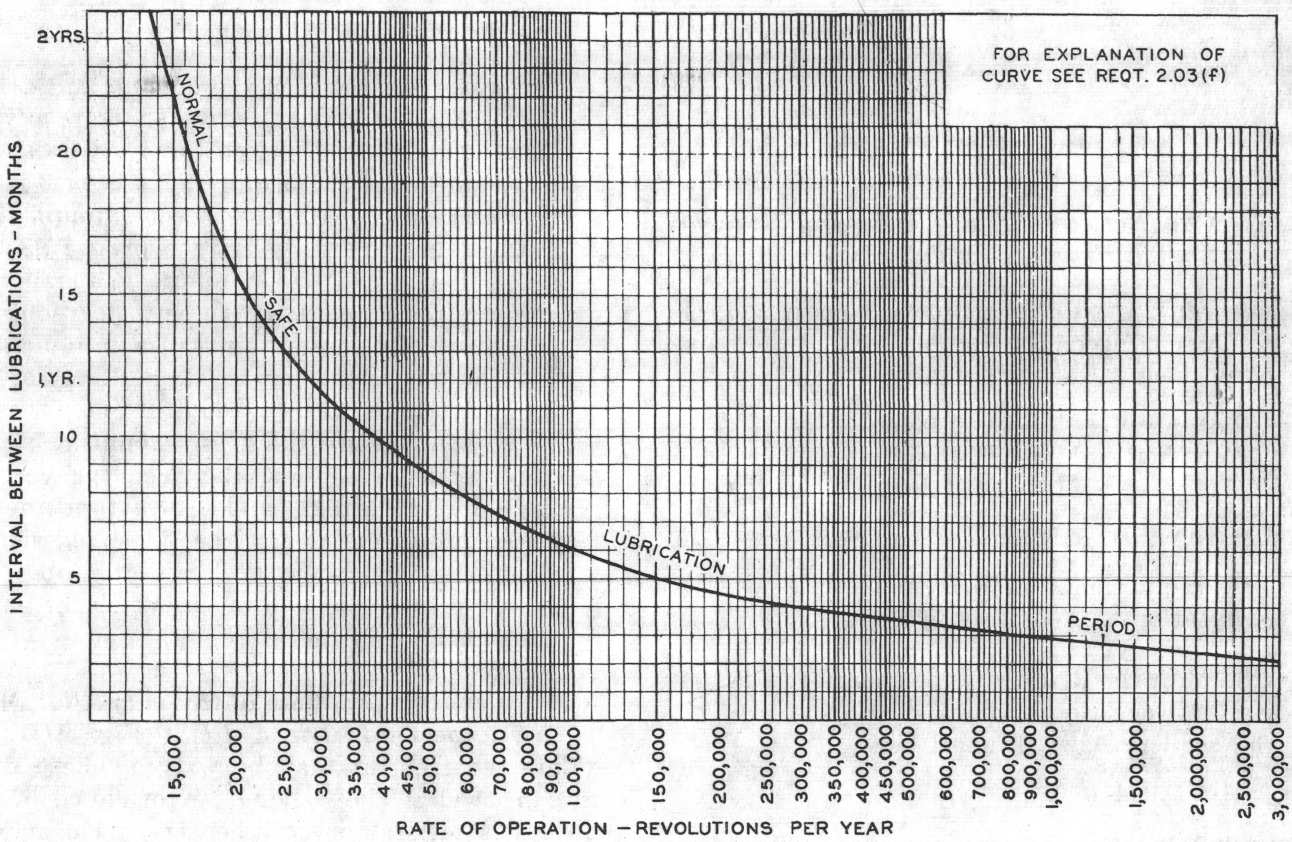

Fig. 3 — Lubrication Intervals For Metallic-Type Sequence Switch Cam-Shaft Bearings

2.06 ***Location of Pointer*** — Fig. 4(A)

(a) The end of the pointer shall

Test — Not touch its index wheel
Readjust — Clear its index wheel by approximately 1/16 inch

Gauge by eye.

On a sequence switch equipped with a Z cam, the pointer may overlap the index wheel but the pointer shall clear the wheel by 1/16 inch.

Gauge by eye.

(b) The pointer shall center approximately on any number of the index wheel when the A cam roller is seated in a crimp of the A cam.

Gauge by eye.

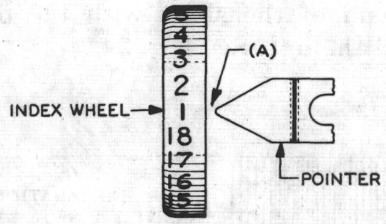

Fig. 4 – Location of Pointer

2.07 ***Gap Between Driven Disc and Sequence Switch Frame*** — Fig. 5(B)

(a) With the drive magnet de-energized, the gap between the driven disc and the frame of the sequence switch shall be

Test — Max 0.040 inch
Readjust — Min 0.024 inch
Max 0.034 inch

Use the 85D, 85E, and 87A gauges.

This requirement shall be met in all positions of rotation.

(b) With the drive magnet energized, the gap between the driven disc and the frame of the sequence switch shall be

Min 0.004 inch

Gauge by eye.

This requirement shall be met in all positions of rotation.

2.08 ***Gap Between Driving and Driven Discs*** — Fig. 5(C)

(a) Except as covered in (b), the gap between the driving disc and the driven disc with the driving disc and the sequence switch cam shaft in any position about their axes shall be

Test — Min, discs shall not touch
Max 0.020 inch
Readjust — Min 0.005 inch
Max 0.020 inch

The maximum limit shall be measured when the shafts are in the positions which bring the two discs farthest apart.

Use the 85A and 85C gauges.

(b) On key listening and position distributing cordless B link, key control, sender and allotter circuits, the gap between the driving and driven discs, measured as in (a), shall be

Min 0.005 inch
Max 0.015 inch

Use the 85A and 85F gauges.

Check the gap between the driving and driven discs with the vertical drive shaft revolving. Rotate the sequence switch slowly by hand and make sure that the requirement is met in all positions. In checking for the maximum limit of the requirement, insert the proper 85-type gauge in the gap and hold the gauge lightly between the fingers. If, in any position, the gauge and discs do not bind, it is an indication that the gap is too large. In checking for the minimum limit of the requirement in cases where space is provided for mounting six or more sequence switches between the vertical drive-shaft bearings, make sure that the requirement is met when the drive magnet of either the sequence switch directly above or the one directly below that on which the gap is being checked is energized.

2.09 ***Vertical Location of Driving Disc With Respect to Driven Disc:*** Fig. 5(D) — (This requirement may be waived where discs are grooved if the driving performance of the switch is satisfactory.) When the drive magnet is energized, the bottom of the driving disc shall not be below the edge of the driven disc nor more than 1/16 inch above it. This requirement

shall be met in all positions of rotation of the sequence switch and driving disc.

Gauge by eye.

2.10 ***Gap Between Driving Disc and Pole Piece:*** Fig. 5(E) — With the drive magnet de-energized, the gap between the driving disc and the pole piece at the point where the driving disc is in a position where it is nearest the pole piece of the drive magnet shall be

Min 0.010 inch
Max 0.020 inch

Use the 85B and 85C gauges.

Check the gap between between the driving disc and pole piece, if possible, when no other magnets associated with the same vertical drive shaft are energized. Do this with the vertical drive shaft revolving by inserting the 85C gauge between the pole piece and the driving disc. With the sequence switch magnet de-energized, there must be a decided drag on the gauge in at least one position of rotation. To check the minimum limit, insert the 85B gauge and make sure that it does not bind in any position of rotation.

2.11 ***Drive Pull:*** There shall be no appreciable slip between the driving and driven discs when the drive magnet is energized.

Gauge by eye and by feel.

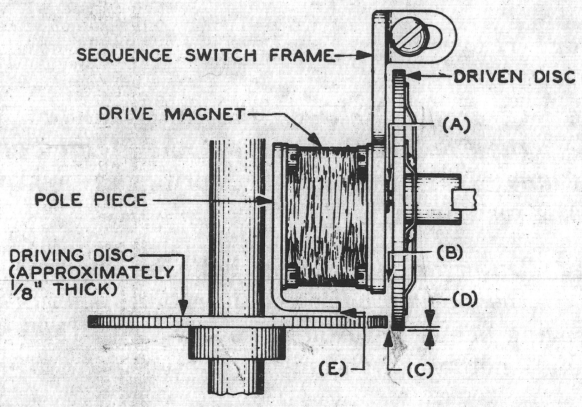

Fig. 5 – Location of Driving and Driven Discs

2.12 ***A Cam-Roller Pressure:*** Fig. 6(A) — With the endplay of the cam shaft within the specified limits, the pressure of the A cam roller against the A cam, measured at a point approximately 1/4 inch back from the center of the roller and with the roller seated in a crimp of the A cam, shall be

Test — Min 400 grams
Max 600 grams
Readjust — Min 425 grams
Max 575 grams

Use the 62B gauge.

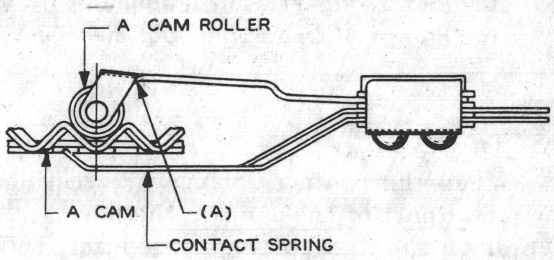

Fig. 6 – A Cam Roller Pressure Requirement

2.13 ***Contact Spring Pressure***

(a) ***Split Contact Springs Only:*** Fig. 7(B) — The contact spring pressure shall be approximately equally distributed between the two prongs. This requirement is met if, with the sequence switch in position 1, the two prongs leave the cam approximately simultaneously [difference not to exceed 0.010 inch (one-half thickness of contact spring) as gauged by eye] when the contact spring is moved away from the cam by applying pressure to the spring at a point back of the slot.

To check (a) of the requirement on an outer contact spring, apply the KS-6320 orange stick back of the slot in the spring, push the spring away from the cam, and observe whether the two prongs leave the cam at approximately the same time. In checking the requirement on an inner spring, the 235 adjuster may be used to push the spring away from the cam.

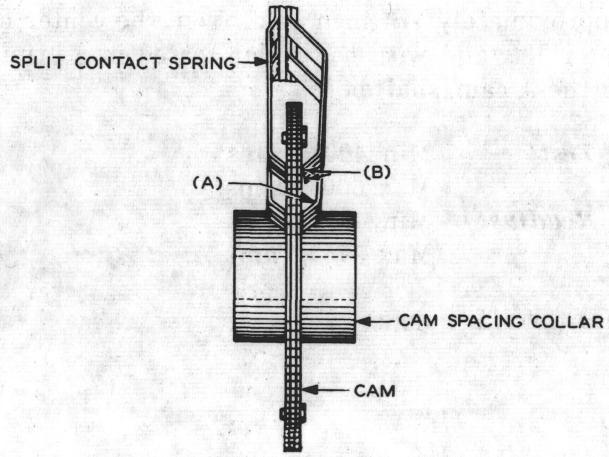

Fig. 7 – Contact Spring Pressure Requirements With the Prongs of One Spring Out of Adjustment

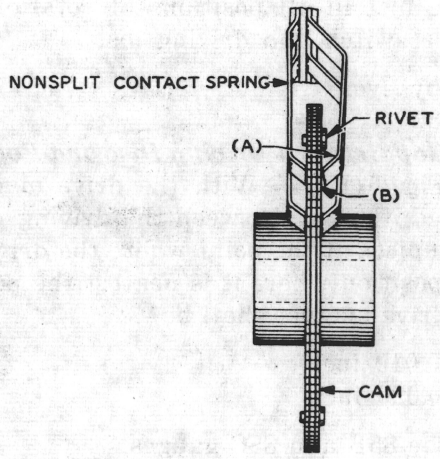

Fig. 8 – Contact Spring Pressure and Parallelism Requirements With One Spring Out of Parallel

(b) ***All Springs:*** Fig. 7(A) and 8(A) — When the contact springs are resting on the metal part of the cams in the normal position or on the first cuttings encountered after the switch is rotated from the normal position, the pressure of the springs against the cams, measured where the springs bend in to make contact with the cams, shall be

Test — Min 25 grams
Max 60 grams
Readjust — Min 30 grams
Max 60 grams

Use the 68B gauge.

In the case of the split contact springs, this requirement applies to the combined pressure of both prongs.

(c) ***All Springs:*** After turnover, as an optional check when the contact springs are resting on the insulation, the pressure of the springs measured as in (b) shall be

Min 15 grams
Max 50 grams

Use the 68B gauge.

2.14 ***Parallelism of Contact Portion of Contact Spring With Face of Cams (nonsplit springs only):*** Fig. 8(B) — The ends of the contact springs shall rest approximately (within 0.005 inch) flat against the metal surface of the cams.

Gauge by eye using the 510C test lamp.

2.15 ***Clearance Between Adjacent Contact Springs and Between the Springs and Framework:*** Fig. 9(A) — Under all conditions, there shall be a clearance between adjacent contact springs and between the springs (including the A spring) and any part of the framework of

Min 1/64 inch

Gauge by eye.

2.16 ***Clearance Between the Inner Surface of the Contact Springs and the Metal Parts of Cams:*** When the contact springs are resting on the insulation:

(a) ***Outer Springs:*** Fig. 9(B) — The part of the spring back of the point where the spring bends in to make contact with the cam shall not touch the metal surface.

(b) ***Inner Springs:*** Fig. 9(C) — There shall be a clearance between the inner surface of the contact springs and the heads of the rivets of

Min 1/32 inch approximately

Gauge by eye.

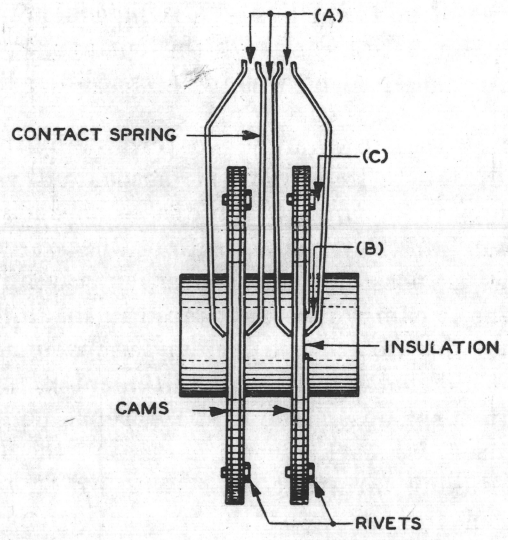

Fig. 9 – Contact Springs and Cams

2.17 ***Vertical Location of Contact Springs:*** The clearance between the edges of the contact springs and the adjacent edges or parts of the cam in all positions of rotation shall be as follows.

(a) ***Inner Edge of Outer Contact Spring, Outer Edge of Inner Contact Spring, and Inner Edge of Inner Contact Spring When Cams Are Electrically Connected to Adjacent Cams:*** Fig. 10(A), 11(A), and 12(A) — There shall be a clearance in a radial direction between these edges of the contact springs and the adjacent edges of the notched out portions of the cams of

Test — Min 0.005 inch
Readjust — Min 0.010 inch

Gauge by eye.

(b) ***Outer Edge of Outer Contact Spring and Inner Edge of Inner Contact Spring When Cams Are Not Electrically Connected to Adjacent Cams*** — Fig. 10(B), 11(B), and 12(B)

Test — These edges of the springs shall not extend beyond the adjacent edges of the cam cuttings.

Gauge by eye.

Readjust — The clearance between these edges of the contact springs and the adjacent edges of the cam cuttings shall be

Min 0.005 inch

Gauge by eye.

(c) ***Inner Edge of Outer Contact Spring and Outer Edge of Inner Contact Spring on Solid Cams (including A cams):*** There shall be a clearance in a radial direction between these edges of the contact springs and the rivets of

Test — Min 0.005 inch
Readjust — Min 0.010 inch

Gauge by eye.

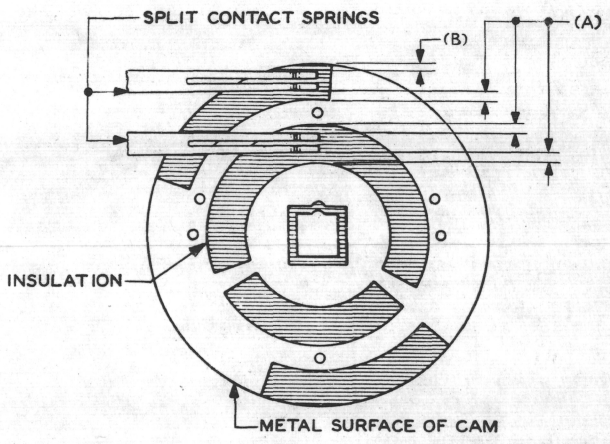

Fig. 10 – Vertical Location of Contact Springs

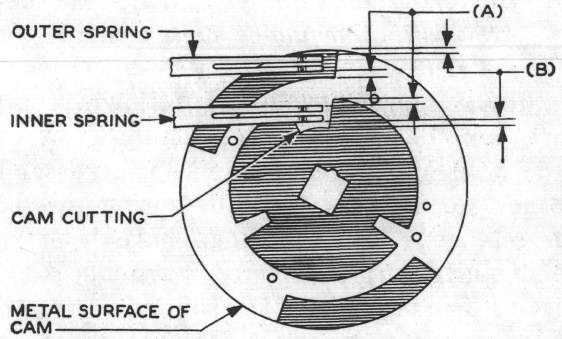

Fig. 11 – Vertical Location of Contact Springs

2.18 ***A Spring Clearance***

(a) Fig. 12(C) — With the A cam roller centered manually in a notch of the A cam at a stop position [Fig. 12(D)], the clearance between the contact end of the A spring and the contact edge just left shall be

1/32 inch (±0.010 inch)

Gauge by eye. The thickness of the A spring is 0.020 inch.

(b) Fig. 12(E) — In all positions of rotation, the clearance between the A cam and the straight portion of the A spring adjacent to the A cam shall be

Test — Min 0.015 inch
Readjust — Min 0.020 inch

Gauge by eye. The thickness of the A spring is 0.020 inch.

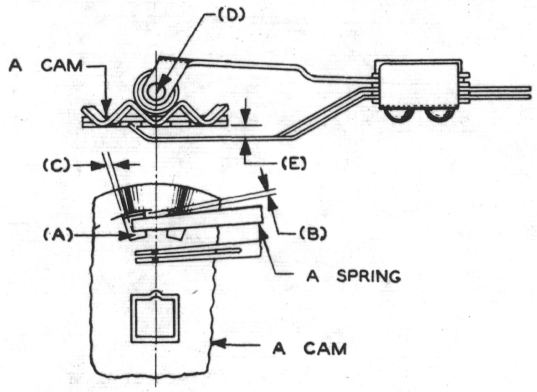

Fig. 12 – Requirements for A Spring

2.19 ***Centering of Contact Springs on Cams (18-position sequence switch only):*** (Applies as a readjust requirement in all cases and as a test requirement in the following cases: where cams have been added, replaced, or relocated; where A cam roller and spring assembly or other spring assemblies, or spring tips have been replaced; where springs have been split after installation; where circuit trouble is experienced.) The position of the contact spring with respect to the cam cuttings, measured at the center of the contact portion of the spring, in the case of (a) and (c) shall be as covered below. In the case of split springs, the requirements shall be met on both prongs of the springs, that is, both prongs shall be within the specified limits.

To check (a), (b), and (c), determine by inspection of the switch and the associated circuit drawings the springs which can be checked with the switch in the normal position. Check as many springs as possible in this position, taking care that the A cam roller is centered in the notch of the A cam. Rotate the switch manually as required and note that the requirement is met on the other springs in the first reference point encountered for each spring as the switch is rotated, taking care that the A cam roller is centered in the notch of the A cam when each spring is checked. These reference points are covered by (a) and (b) for outer cuttings and by (c) for inner cuttings. If trouble has been experienced on any particular cam cutting, make an additional check to see that the requirement is met on the cutting on which trouble is suspected. As the switch is rotated, check that (d) of the requirement applying to the A cams is met and note also that requirement 2.20 covering special spring adjustment is met when specified.

(a) ***Outer Cuttings (except the A cam):*** With the A cam roller centered manually in any notch of the A cam, the distance between the contacting edge of the spring (or the center of the contacting surface in the case of worn springs) and any one of the springs mentioned below shall be

Min 1/32 inch
Max 1/8 inch

Gauge by eye.

(1) Fig. 13(A) and 14(A) — The beginning of any cutting starting with a whole number with the spring resting on the metal portion of the cam.

(2) Fig. 15(A) — The end of any cutting ending in a whole number with the spring resting on the metal portion of the cam.

(3) Fig. 15(B) — The beginning of any cutting starting with a half number with the spring resting on the insulation.

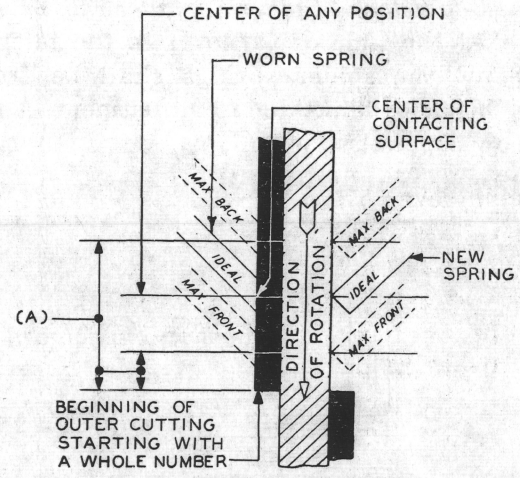

Fig. 13 – Tolerances for Centering of Worn Contact Springs on Cams (outer cuttings)

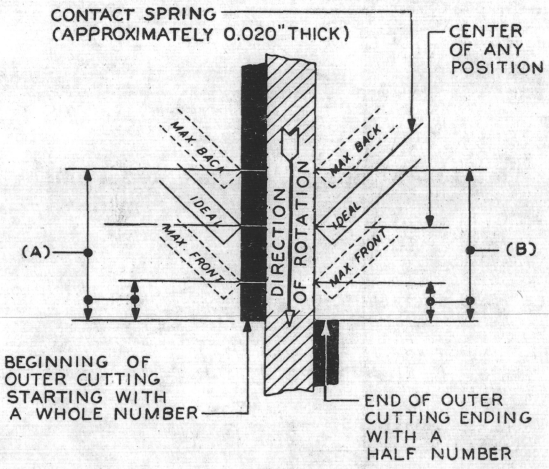

Fig. 14 – Tolerances for Centering of Contact Springs on Cams (outer cuttings)

(4) Fig. 14(B) — The end of any cutting ending in a half number with the spring resting on the insulation.

(b) ***Outer Cuttings Starting With a Half Number:*** Fig. 15(C) — With the A cam roller centered manually in any notch of the A cam and with the contact spring resting on the insulation, the contact spring shall not make contact with the beginning of any cutting starting with a half number.

Gauge by eye.

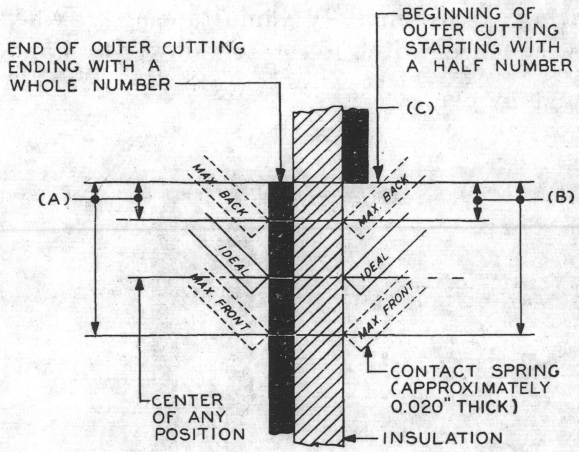

Fig. 15 – Tolerances for Centering of Contact Springs on Cams (outer cuttings)

(c) ***Inner Cuttings (except the A cam):*** Fig. 16(A) — With the A cam roller centered manually in any notch of the A cam and with the spring resting on the metal portion of the cam, the distance between the beginning of a cutting starting with a whole number and the contacting edge of the spring (or the center of the contacting surface in the case of worn springs) shall be

Min 0.018 inch
Max 0.072 inch

Gauge by eye.

(d) ***A Cams Only:*** When the cam-shaft assembly is rotated manually, the A spring shall make contact with the A cam before the contact springs break contact on cuttings ending in a whole number. This requirement need be checked on only one cutting for each cam other than the A cam.

Gauge by eye.

2.20 *Special Spring Adjustment*

(a) When specified on the circuit requirement table, special sequence requirements shall be met.

(b) ***Split Contact Springs Only:*** When specified on the circuit requirement table, the two prongs shall be in approximate alignment. This requirement shall be considered as having been met if both prongs leave the end of a cam

cutting approximately simultaneously when the sequence switch is rotated slowly by hand.

Gauge by eye.

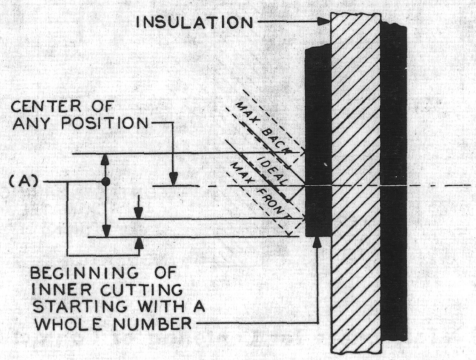

Fig. 16 – Tolerances for Centering of Contact Springs on Cams (inner cuttings)

2.21 ***B Spring Clearance (only 20-position sequence switches not having A cams):*** Fig. 17(A) and 18(A) — When the sequence switch is at rest in position 1 as defined in 1.06, the end of the contact spring on the B cam through which the sequence switch is controlled (left outer No. 2 spring or right outer No. 3 spring, as the case may be) shall be

Min 0.035 inch
Max 0.055 inch

from the contact edge of the cam cutting just left.

Gauge by eye.

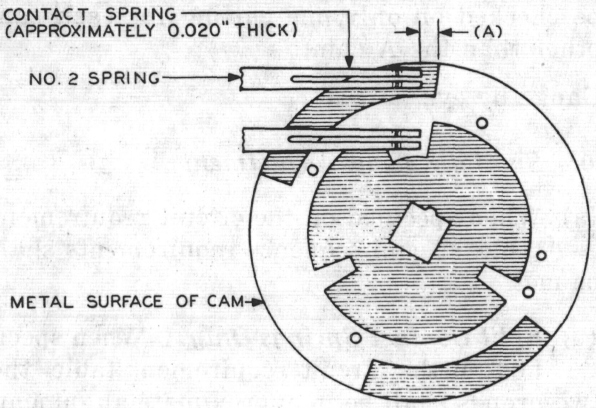

Fig. 17 – B Spring Clearance Requirement

2.22 ***Condition of Spider Springs:*** Fig. 19(A) — At the time of turnover to the telephone company, the spider springs shall be free of sharp bends or kinks due to adjustment. A gradual bow is permissible.

Gauge by eye.

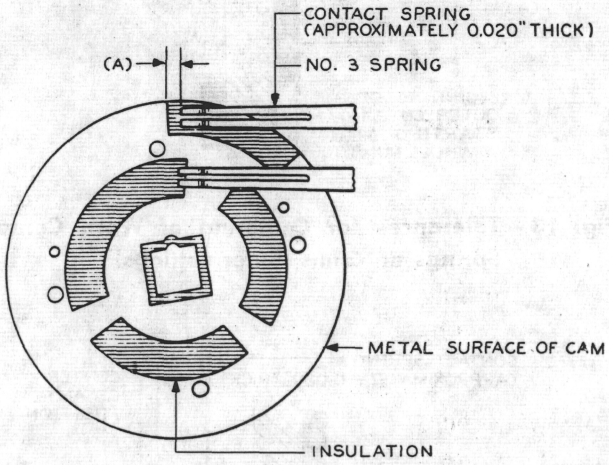

Fig. 18 – B Spring Clearance Requirement

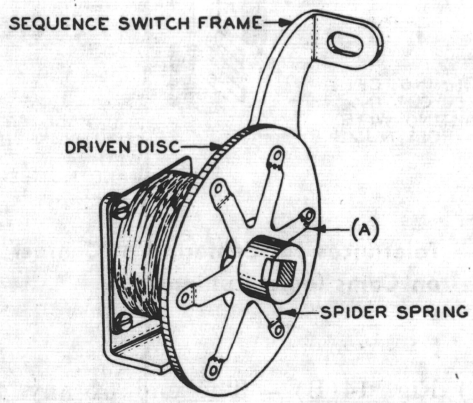

Fig. 19 – Spider Spring Requirement

2.23 ***Clearance Between Mounting Screws and Right-Hand End of the Slots in Sequence Switch Frame:*** Fig. 20(A) and (B) — At the time of turnover to the telephone company, with the sequence switch adjusted to meet the above requirements, there shall be a clearance between the sequence switch mounting screws and the

right-hand end of the slots in the sequence switch frame of

Min 1/32 inch

Gauge by eye.

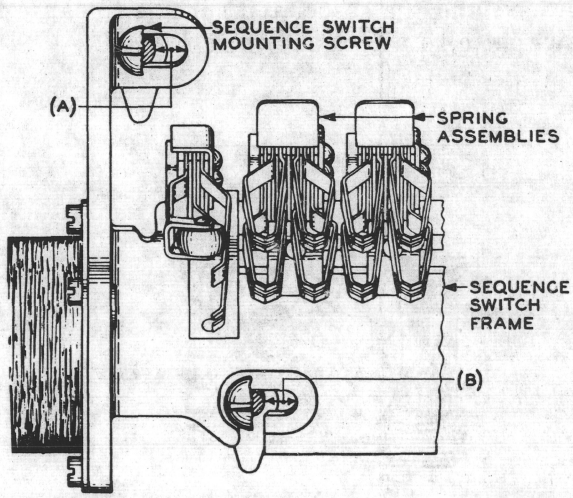

Fig. 20 – Sequence Switch Mounting Screw Requirement

3. ADJUSTING PROCEDURES

3.001 *List of Tools, Gauges, and Materials*

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
33	11/32-Inch Single-End Socket Wrench
203	Index Wheel Holder
206	30-Degree Offset Screwdriver
207	90-Degree Offset Screwdriver
215	Spring Adjuster
218B	A Cam Short-Circuiting Tool
235	Spring Adjuster
236	9/16-Inch Open Single-End Offset Wrench
256	Spring Adjuster
267B	Contact Spring Insulator ←
353C	Grease Gun (equipped with 570A straight nozzle)
354	Cam Locating Tool
357	Spring Contact Clip and Insulator←
378A	Friction Surface Restorer
401A	Oil Gun
462A	Spring Adjuster
510C	Portable Lamp (equipped with 562A offset tip and W2BL cord)
KS-6098	Wrench
KS-6263	Wrench
KS-6320	Orange Stick
KS-14164	Brush
R-1051	File
R-1274	File
R-1482	File
R-2142	Adjuster
—	P-Long-Nose Pliers (or the replaced 6-1/2 inch P-long-nose pliers) ←
—	4-Inch E Screwdriver (or the replaced 4-inch regular screwdriver) ←
1W13A	Cord (equipped with a 365 connecting clip at one end and a 419A test connector at the other end)
GAUGES	
62B	0-700 Gram Gauge
66D	Thickness Gauge Nest
68B	70-0-70 Gram Gauge
85A	0.005-Inch Thickness Gauge
85B	0.010-Inch Thickness Gauge
85C	0.020-Inch Thickness Gauge
85D	0.024-Inch Thickness Gauge
85E	0.034-Inch Thickness Gauge
85F	0.015-Inch Thickness Gauge
87A	0.022- and 0.040-Inch Double-End Thickness Gauge

CODE OR SPEC NO.	DESCRIPTION
MATERIALS	
→KS-2423	Cloth
KS-7860	Petroleum Spirits
KS-14666	Cloth
KS-16326 L1	Oil
→KS-19566 L1	Emulsion (see 3.007)
—	Piece of Canvas
→—	Veedol All Purpose Grease (or the replaced Veedol medium cup grease)
—	Clear Varnish
—	22-Gauge Bare Tinned Copper Wire
→—	1 Gallon Can

3.002 Make all circuits associated with the sequence switch to be inspected or adjusted busy in the approved manner before the work is started.

3.003 Before checking or readjusting to meet the requirements specified herein which require that the switch be rotated, isolate the registers operated through sequence switch cams by insulating the springs controlling their operation with a 357 spring contact clip and insulator or a 267B contact spring insulator.

3.004 While checking or readjusting to meet some of the requirements specified herein, as for example requirement 2.08, it will be necessary to remove the battery fuse which supplies current to the drive magnet. In addition, it may be necessary to remove the fuse supplying ringing current when checking or readjusting to meet some of the requirements, as for example requirement 2.19.

Note: When removing fuses supplying ringing leads, all circuits on the one side of a frame (and in some cases circuits on other frames) may be affected. Make sure that such circuits are removed from service before the fuse is removed.

3.005 ***Methods of Rotating Sequence Switches Electrically***

(a) The 218B A cam short-circuiting tool may be used to cause the sequence switch to rotate except in the case of 20-position sequence switches. Apply the tool between the A cam and the associated springs to cause the switch to rotate as shown in Fig. 21.

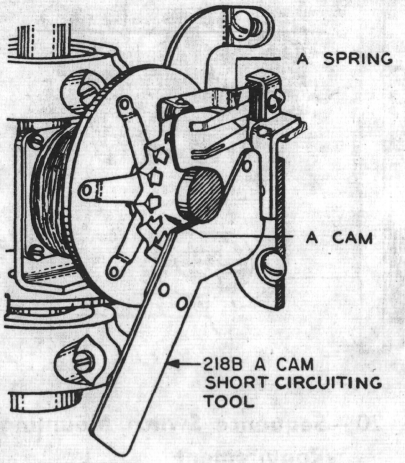

Fig. 21 – Method of Rotating Sequence Switches Electrically With the 218B A Cam Short-Circuiting Tool

(b) To rotate the sequence switch using the 1W13A cord, connect the 419A test connector to the A cam roller spring and connect the 365 connecting clip to ground as shown in Fig. 22. In the case of 20-position sequence switches having no A cam rollers, connect the 419A test connector to the contact spring on the B cam through which the sequence switch is controlled (left outer No. 2 or right outer No. 3 as the case may be).

(c) When the switch is to be rotated only a few revolutions, it may be advantageous to rotate the switch by short-circuiting the A spring and the A cam roller spring by means of a screwdriver blade.

3.006 To facilitate the inspection and adjustment of the driving discs and drive magnet, the vertical drive shaft guard may be removed from the frame by removing the guard mounting screws with the 4-inch E screwdriver.

If, however, the guard is mounted on rotating brackets, it may be shifted out of the way without removing it from the frame.

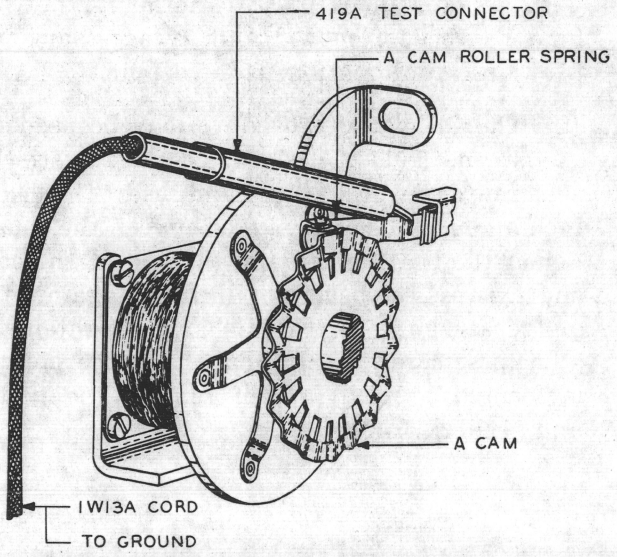

Fig. 22 – Method of Rotating Sequence Switches Electrically With the 419A Test Connector, the 365 Connecting Clip, and 1W13A Cord

3.007 The KS-19566 L1 emulsion must be diluted as follows before using as covered in 3.11(4). Place about 1/2 gallon of clean water in the gallon can. Thoroughly shake the emulsion, add 2 ounces of it to the water in the can, and stir lightly. The bottle containing the KS-19566 L1 emulsion is provided with a screw cap which has a 1-ounce capacity for measuring the emulsion. Because one component of the emulsion solution will evaporate if it is kept in an open container, do not use the solution after more than 8 hours from the time of preparation.

3.01 ***Cleaning*** (Reqt 2.01)

(1) Scrub or scour and scrub cams in the approved manner.

3.02 ***Operation of A Cam Roller*** (Reqt 2.02)
3.03 ***Lubrication*** (Reqt 2.03)

(1) ***A Cam Roller:*** If the A cam roller binds and dust or a gummy substance adheres to the bearings, flush the bearings thoroughly with KS-7860 petroleum spirits applied with the KS-14164 brush. Take any additional precautions as may be required to prevent the petroleum spirits from splattering on the adjacent apparatus. After the bearing has been thoroughly cleaned with petroleum spirits, allow it to dry and then relubricate it as follows.

(2) Apply one drop of KS-16326 L1 oil to the top of the roller with the 401A oil gun or the piece of 22-gauge bare tinned copper wire. Wipe off any excess oil that may have crept onto the outer surface of the roller or the A cam, with a KS-14666 cloth.

(3) ***Nonmetallic Cam-Shaft Bearings:*** Do not lubricate the bearings at the driven disc end of the cam-shaft assembly. Also, do not lubricate the bearing at the index wheel end except when the bearing pin is first installed or when the bearing pin is removed for other reasons. When lubricating the bearing at the index wheel end, insert the tip of the nozzle of the 353C grease gun in the hole in the end of the cam shaft and depress the piston to the end of the stroke. Then release the piston. In removing the grease gun, draw the nozzle over the bearing surface so that the lubricant will be deposited in the bearing. In reassembling the bearing pin, make sure that requirement 2.05 is met. Wipe off any grease which may creep out of the bearing with a KS-14666 cloth.

(4) ***Metallic Cam-Shaft Bearings:*** Loosen the stirrup setscrew with the 4-inch E screwdriver or with the KS-6263 wrench, depending on whether the setscrew has a slotted or a hexagonal head, and shift the cam-shaft assembly to the right just sufficiently to allow the insertion of the nozzle of the 353C grease gun. Then slightly retighten the stirrup setscrew.

(5) To lubricate the bearing at the driven disc end of the cam-shaft assembly, rest the end of the nozzle against the bearing surface of the cam shaft and depress the piston to the end of its stroke. Then release the piston. In removing the grease gun, draw the nozzle over the bearing surface of the cam shaft so that the lubricant will be deposited on the bearing surface. Make sure that the lubricant does not reach the driving or the driven discs.

(6) Apply the lubricant to the bearing surface of the bearing pin as shown in Fig. 23.

(7) After the cam-shaft bearings have been lubricated, reset the bearing pin and tighten the stirrup setscrew making sure that requirement 2.05 is met.

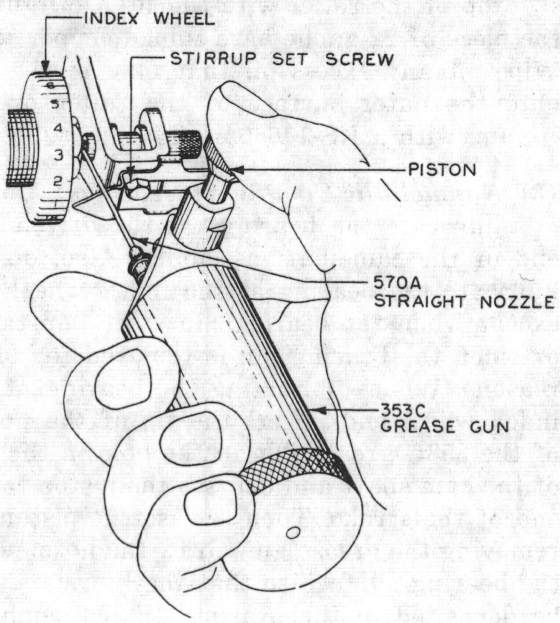

Fig. 23 – Method of Lubricating the Cam-Shaft Bearing at Index Wheel End

3.04 ***Record of Lubrication*** (Reqt 2.04)
No procedure.

3.05 ***Endplay of Cam Shaft*** (Reqt 2.05)
3.06 ***Location of Pointer*** (Reqt 2.06)

(1) If the requirement is not met, readjust as follows. If more than the maximum allowable endplay is found, loosen the stirrup setscrew with the 4-inch E screwdriver or the KS-6263 wrench, depending on whether the setscrew has a slotted or a hexagonal head, and press the bearing pin toward the left. Locate the pointer as covered in (3) and then retighten the stirrup setscrew. This will probably remove all endplay. If no endplay is perceptible, apply the tip of the 4-inch E screwdriver or the KS-6263 wrench to the edge of the lug directly behind the knurled end of the bearing pin and, while pressing toward the cam-shaft assembly, permit the tool to slip off and strike against the sequence switch frame with a snap. Check to see whether or not the bind has been removed and, if necessary, repeat the aforementioned operation.

(2) The following procedure may be used instead of (1) if desired. Loosen the stirrup setscrew as covered in (1) and insert the 0.003-inch blade of the 66D gauge between the shoulder of the bearing pin and the end of the cam shaft. Press the bearing pin firmly against the gauge as shown in Fig. 24 and retighten the stirrup setscrew, taking care that the pointer is located properly. Then remove the gauge and recheck for endplay.

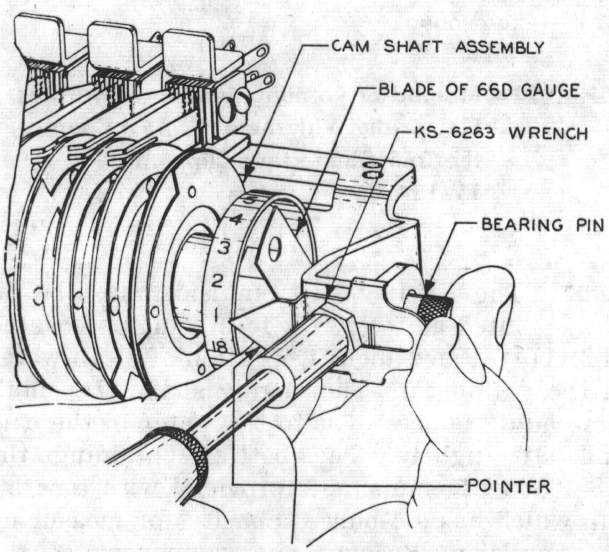

Fig. 24 – Method of Adjusting Endplay of Cam Shaft

(3) ***Location of Pointer:*** If the requirement is not met, loosen the stirrup setscrew as covered in (1). Locate the pointer as required and then retighten the stirrup setscrew. Make sure that requirement 2.05 is met. If the pointer overlaps the index wheel on a sequence switch equipped with a Z cam, check for the clearance requirement. Adjust the pointer, if required, away from the wheel using the P-long-nose pliers.

3.07 ***Gap Between Driven Disc and Sequence Switch Frame*** (Reqt 2.07)

(1) If the requirement is not met due to a wobbly driven disc, adjust the spider to correct the gap. Revolve the driven disc to the point where the gap between driving and driven discs is a minimum and then, with the index finger and thumb on the periphery as shown in Fig. 25, force the top of the disc towards the left and the bottom of the disc towards the right. Revolve the disc to check for wobble and, if necessary, repeat the adjusting operation until the wobble is reduced sufficiently to meet the requirements.

(2) If the requirement cannot be met as covered in (1), use the 235 spring adjuster as shown in Fig. 26 and adjust each of the spider springs an equal amount to increase or decrease the gap as required. Exercise extreme care not to kink or damage the spring.

(3) Do not take out the cam-shaft assembly to adjust for a wobbly disc or for any other reason unless it is absolutely necessary. Wobbly driven discs can usually be corrected by the method covered in (2). If necessary to remove the driven disc for any reason, however, follow the procedures covered in Section 030-801-801. If the spider is bent so as to cause an eccentric motion, straighten it at this time.

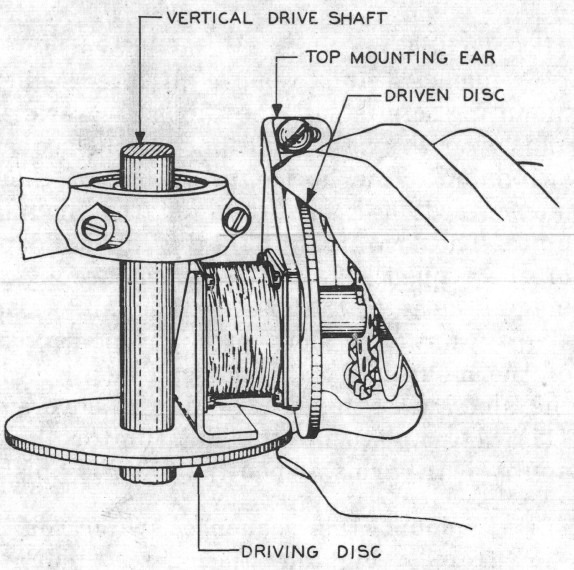

Fig. 25 – Method of Correcting Wobbly Driven Disc

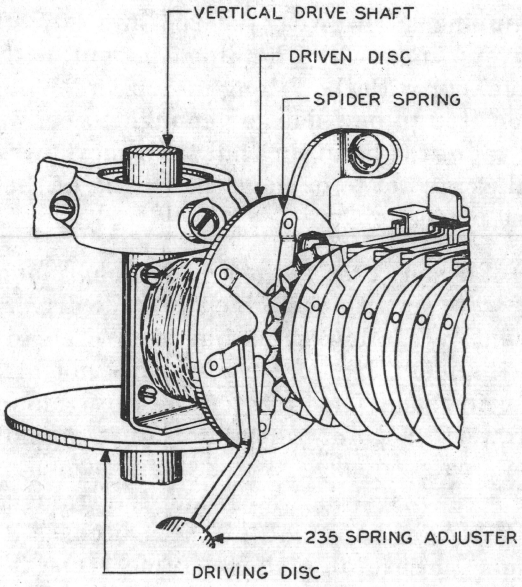

Fig. 26 – Method of Using the 235 Spring Adjuster to Adjust the Spider Spring

(4) If the requirement still cannot be met, it is probably due to a worn bearing. Replace the bearing as covered in Section 030-801-801.

(5) When any change is made in the adjustment of the driven disc, make sure that requirement 2.08 is met.

3.08 ***Gap Between Driving and Driven Discs*** (Reqt 2.08)

(1) If the requirement is not met, de-energize the drive magnet of the adjacent sequence switch and readjust the gap toward the maximum in the following manner with the vertical drive shaft revolving.

(2) In cases where the contact protection unit is mounted on the wiring side of the frame by means of the sequence switch mounting screws, remove the contact protection mounting nut with the 33 wrench or in case there is not sufficient clearance to permit use of the wrench, with the P-long-nose pliers. On contact protection units where the capacitor is mounted with the long axis perpendicular to the sequence switch mounting bar, it will be necessary to remove the capacitor from the bracket in order to obtain access to the mounting nut on the top sequence switch mounting screw. To do this, remove the capacitor bracket

clamping screw with the 206 and 207 screwdrivers, meanwhile holding the nut with the fingers or with the P-long-nose pliers. Move the capacitor to one side far enough to permit removal of the mounting nut with the 33 wrench. Take care not to damage the wiring of the contact protection unit.

(3) Loosen the sequence switch mounting screws with the 4-inch E screwdriver sufficiently to allow the sequence switch to rest on the mounting screws if it does not already rest on them. Then tighten the three mounting screws to a point where it is just possible to move the sequence switch frame when using the screwdriver as a lever and the frame angle at the right-hand end of the switch as a fulcrum. In case of a short frame (type A) sequence switch, move the sequence switch frame by tapping it with a screwdriver.

(4) Force the sequence switch slowly towards the left until the gap between the two discs at the closest point is approximately 0.010 inch. The screws being friction-tight, the switch will stay in this position. Make this adjustment by sight, using the top mounting ear of the switch next below as a reflector or using a piece of white cardboard or paper. Generally the sight method results in quicker and better work, but it is advisable to check the sight adjustments occasionally with the 85A and 85C gauges. Take care to keep the gauges within the ground portion of the driven disc.

(5) Revolve the driven disc by means of the index wheel and if the gap is more than the maximum specified at any point, correct it in one of the following ways.

(6) If the requirement is not met due to a wobbly driven disc, correct this condition as covered in 3.07.

(7) If the requirement cannot be met due to either a bowed vertical drive shaft or an eccentric driving disc, or both, refer to the appropriate section for correction.

(8) When the disc gap is satisfactory, securely tighten the sequence switch mounting screws. In order to cause the least disturbance of the adjustment, press the sequence switch frame against the mounting bar and tighten the bottom left-hand screw first. Recheck the adjustment and if still satisfactory, tighten the bottom right-hand screw and then the top screw.

(9) If the requirement is not met and the sequence switch has been moved as far toward the drive shaft as the slot in the sequence switch frame will permit, it will be necessary to file the slots in the mounting plate. Proceed as follows.

(10) Make the circuit busy in which the sequence switch upon which work is to be done is located. Do this for the sequence switch above and below the one upon which work is to be done. Remove the fuses on these circuits. Spread canvas on the switch below the one on which the slots are to be filed.

(11) To file the slot on the lower right-hand corner of the sequence switch (as viewed from the front), remove both of the bottom sequence switch mounting screws with the 4-inch E screwdriver and loosen the screw in the upper left. Raise the right-hand part of the sequence switch using the screw in the upper left-hand slot as a pivot, until the slot is clear of the mounting plate. File the slot with an R-1274 file sufficiently to insure that the sequence switch can be moved close enough to the drive shaft so that the maximum clearance requirement between the driving disc and the driven disc can be met. Apply clear varnish to the part which has been filed.

(12) To file the slots at the left of the sequence switch, remove all three sequence mounting screws with the 4-inch E screwdriver and lower the right-hand part of the sequence switch until the horizontal flange of the sequence switch frame rests on the mounting plate. Then carefully pull the left-hand part of the sequence switch forward, keeping the magnet clear of the driving disc, and raise it slightly until the slots in the frame are clear of the mounting plate and can be filed. File the slots with the R-1274 file as covered in (11). Attempt to file the slots uniformly and apply clear varnish when the filing is finished.

(13) Remount the sequence switch on the frame. Tighten the three mounting screws to a point where it is just possible to move the sequence switch frame when using

the screwdriver as a lever and the frame angle at the right-hand end as a fulcrum. In case of a short frame type A sequence switch, move the sequence switch frame by tapping it with a screwdriver, then proceed to position the switch frame as covered in (4). If the sequence switch still cannot be positioned properly, it will be necessary to refile the slots until the requirement can be met.

(14) Retighten all sequence switch mounting screws securely. Remount the contact protection units if removed. When retightening the capacitor bracket clamping screw, tighten it only tight enough to hold the capacitor firmly in position, since there is danger of damaging the capacitor case if the screw is made excessively tight. Replace any fuses which may have been removed and remove make-busy plugs so as to restore the circuits to service.

3.09 ***Vertical Location of Driving Disc With Respect to Driven Disc*** (Reqt 2.09)

3.10 ***Gap Between Driving Disc and Pole Piece*** (Reqt 2.10)

(1) ***General:*** Since it will be necessary to stop the vertical drive shaft when adjusting for requirement 2.09, make this adjustment at a time when it will be least likely to interfere with service.

(2) Before making any adjustments for these requirements, check all sequence switches in the bay to see whether these requirements are met. Also check the sequence switches with respect to grooved driven discs and shiftable magnet pole pieces since these conditions affect the action to be taken.

(3) If the discs are not grooved, proceed as covered in (7) through (13). If the discs are grooved, proceed as covered in (14).

(4) If the majority of the discs are too high or too low with respect to the driven disc or pole pieces or both, it is an indication that the position of the vertical drive shaft has shifted. In such cases, determine whether the provisions of the appropriate section will permit raising or lowering the vertical drive shaft sufficiently to obtain a mean adjustment for a majority of the discs. If so, proceed to raise or lower the vertical drive shaft as covered in that section and as covered in (7) and (8).

(5) If the provisions of the section do not permit sufficient movement of the vertical drive shaft, readjust the individual driving discs as covered in (9) through (13).

(6) When adjusting to meet either of these requirements, recheck to see that the other requirement is still met.

(7) ***Majority of Driving Discs Too High or Too Low With Respect to Pole Piece or Driven Disc:*** On later installations, the driving disc above the second bearing from the bottom of the vertical drive shaft is used as a reference disc for locating the vertical drive shaft with respect to the sequence switch drive magnet pole pieces and driven discs. On frames where the sequence switch position opposite this driving disc is unequipped, the disc nearest the second bearing and associated with an equipped position may have been used as a reference disc. In either case, the reference disc is distinguished by a red line on the upper side of the disc.

(8) In shifting the position of the vertical drive shaft on a frame where a reference disc is found, rotate the shaft to a position so that the red line on this disc is in alignment with the front edge of the pole piece as shown in Fig. 27. Then raise or lower the vertical drive shaft until the gap between the pole piece and the reference disc is satisfactory as gauged with an 85-type gauge. If no driving disc is marked as a reference disc, select as a substitute a driving disc which is free from wobble for use in making this adjustment. This will usually locate all of the driving discs properly with respect to all of the sequence switches in the bay. However, should it be necessary to move an individual driving disc or to correct the gap between the pole piece and driving disc of any sequence switch, proceed as covered below.

(9) ***Individual Driving Disc Too High or Too Low With Respect to the Driven Discs:*** If only a few driving discs are too high or too low with respect to the driven discs, stop the vertical drive shaft and loosen the driving disc setscrew with the 4-inch E screwdriver or with

the KS-6098 wrench, depending upon whether the screw is a fillister head setscrew or a Bristo setscrew and raise or lower the driving disc as required. Tighten the driving disc setscrew. In order to raise the driving disc, it may be necessary to raise either the pole piece or the complete drive magnet assembly as covered in (12) in order to prevent the driving disc from rubbing on the pole piece.

(10) Magnets with coil coverings of gray linen or white cellulose acetate have elongated screw holes on the pole-piece side, and the pole pieces on these magnets may be moved in a vertical direction. The pole pieces on magnets having a black coil cannot as a rule be shifted. The magnets as a whole should not be raised, lowered, or tilted from a level position.

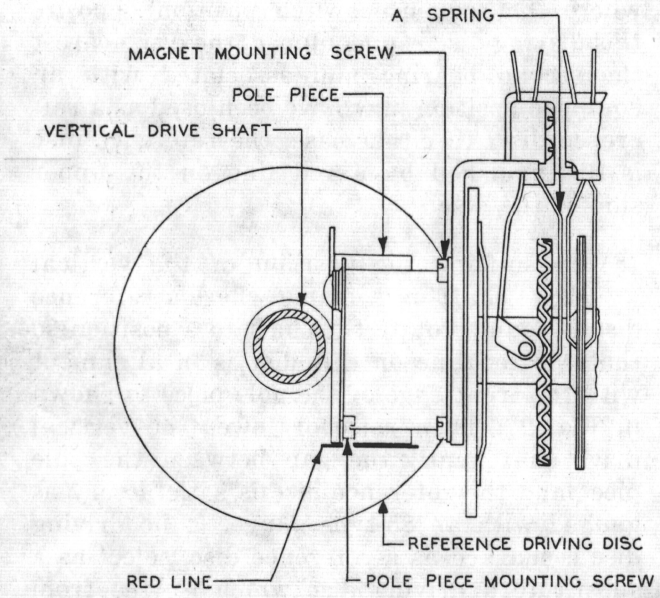

Fig. 27 – Method of Lining Up Reference Disc With Pole Piece

(11) Do not loosen the sequence switch mounting screw or shift the position of the sequence switch to adjust for these requirements except where this is necessary in order to loosen the pole-piece or magnet mounting screws as covered in (12). With the driving disc setscrew only lightly tightened, it is permissible to tap lightly on the top surface of the disc with the handle of the screwdriver to move the driving disc downward. Take care not to tap the driving disc down too far and do not tap it upward as this will groove the shaft and, when the disc is raised, it will not hold its adjustment.

(12) ***Where Requirement of Vertical Location of Driving Discs With Respect to the Pole Piece Cannot Be Met by Raising or Lowering the Drive Disc:*** It will be necessary to raise or lower the pole piece or the drive magnet or both. (Magnets with coil coverings of gray linen or white cellulose acetate have elongated screw holes on the pole-piece side and the pole pieces on these magnets may be moved in a vertical direction. The pole pieces on magnets having a black coil cannot as a rule be shifted. The magnets as a whole should not be raised, lowered, or tilted from a level position.) Turn the vertical drive shaft to the position in which the driving disc setscrew is under the drive magnet. Experience has shown that this is the position in which the gap between the driving disc and the pole piece is the smallest. Then loosen the pole-piece or magnet mounting screws with the 206 and 207 offset screwdrivers, raise or lower the pole piece or magnet as required, and tighten the screws. In order to obtain access to the rear pole-piece or magnet mounting screws, it may be necessary to remove the sequence switch mounting screws as covered in 3.08 and pull the switch forward, taking care not to damage the wiring. In remounting the switch, make sure that requirement 2.08 is met.

(13) If the requirements still are not met, move the driving disc up or down as covered in (9).

(14) ***Grooved Disc:*** In cases where the apparatus has been in service for some time with the driving disc set below the limit specified and a groove has been worn in the driven disc, it will not be necessary to relocate the driving disc to meet the requirements unless the operation of the switch indicates that such a change is desirable. If the driving disc has been peened over, proceed as covered in (15). If a groove with sharp edges is worn in the driven disc, it may be necessary to replace the disc as covered in Section 030-801-801.

Note: A grooved driven disc for the purpose of this procedure is defined as one grooved deeply enough so that a shift in the

driving disc to meet the requirement would reduce the area of contact between the driving and driven discs to such an extent that it appears that operation of the switch would be seriously affected.

(15) ***Peened Driving Discs:*** If the edge of the driving disc has become turned up or there are metal slivers on the upper surface or undersurface, hold an R-1051 file flat on the affected surface of the driving disc so that part of the file extends over the edge of the disc until, with the driving disc rotating, the condition is corrected. Do not apply the file to the driving edge of the disc. After completing the filing operation, check the operation of the associated sequence switch for drive pull. Take precaution against touching the driving disc to prevent personal injury.

3.11 ***Drive Pull*** (Reqt 2.11)

(1) To determine whether or not a sequence switch is slipping, energize the sequence switch drive magnet as covered in 3.005 and exert a slight pressure against the index wheel as the switch rotates. Check for slipping by sight and by feel.

Caution: Exercise care in applying pressure to the index wheel as excessive braking will cause the switch to slip, resulting in worn and polished surfaces on the driving and driven discs.

(2) If an appreciable slip between the driving and driven discs is noted, de-energize the drive magnet and make sure that the discs are free from the slightest traces of oil or grease. To clean the discs of oil or grease, proceed as follows.

(3) Examine the flat surface of the driving disc and adjoining portion of the shaft for oily residue. If areas are wet with oil, wipe off the accumulations with a KS-14666 cloth moistened with KS-7860 petroleum spirits. Shift the cloth as required to present a clean section for each disc. Also examine the edges of the driving disc for peening and metal slivers and, where required, proceed as covered in 3.09-3.10(15).

(4) Fold a clean KS-2423 cloth to form a pad 2 to 2-1/2 inches square. Moisten the cloth with the emulsion solution prepared as covered in 3.007. Squeeze the cloth lightly to remove excess solution and proceed as follows.

(a) To clean the driving disc, press the moist cloth firmly against the top and bottom horizontal surfaces and the friction surface of the driving disc during three or four revolutions of the disc. Then, while exerting pressure against the disc surfaces, use a dry KS-2423 cloth to clean and dry the driving disc during several revolutions of the disc. Normally this will adequately clean the disc. If the disc is unusually dirty, repeat the above cleaning and drying operations. Discard the cloth when it becomes wet or badly soiled.

(b) To clean the driven disc, press the moist cloth against the disc friction surfaces and apply a forward and backward motion to rotate the switch so that all friction surfaces are reached, taking care not to distort the driven disc spider spring. Then wipe the friction surfaces with a dry KS-2423 cloth to clean and dry the disc.

(c) Refold the KS-2423 cloth used with the emulsion solution to present a clean surface for cleaning the next pair of discs. Rinse the cloth in the solution after cleaning each pair of discs. See 3.11 (16).

(5) If the iron framework is painted with asphaltum paint, exercise care that the cloth does not come in contact with the framework since the emulsion solution or petroleum spirits will dissolve the paint, which may be carried to the disc driving surfaces.

(6) If it is found that there is an appreciable slip between the driving and the driven discs after the cleaning operation has been performed as covered in (3) and (4), it will be necessary to apply the 378A friction surface restorer to the driving disc as shown in Fig. 28 using the following methods.

(7) Grasp the stone on the 1/4-inch sides close to the holder and remove both the cloth and the stone simultaneously from the holder by working the stone gently from side to side to prevent breakage and at the same

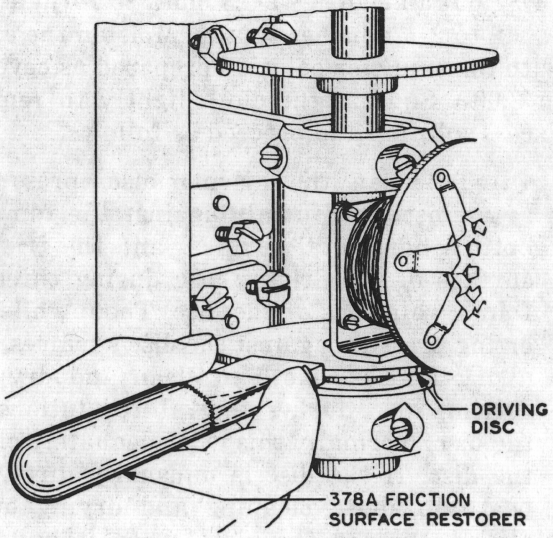

Fig. 28 – Method of Restoring Friction Surfaces of Driving Disc

time exerting an outward pull. Immerse the stone in water to saturate it and fill the tube approximately 2/3 full of clean water. Place the narrow side of the cloth over the end of the stone to be inserted in the tube so that the ends of the cloth can be folded down over the wide sides of the stone. Pull over the superfluous cloth on the long narrow sides of the stone and insert the stone and the cloth in the tube. Shake the tube in a lengthwise direction to work the water out over the stone. After the entire stone has been wet in this manner, clean the end of the stone to be applied to the disc with a moistened KS-14666 cloth. Always keep the stone cleaned in this manner while using it.

(8) To keep the stone in proper condition and obtain the best results, do not permit oil or grease to come in contact with the stone. Always use the stone wet since the water prevents oil and grease from collecting in and filling the pores of the stone. Clean the used surface of the stone frequently and when necessary dress it flat on an R-1482 file.

(9) Energize the drive magnet as covered in 3.005, rotate the sequence switch by hand if necessary and at the same time apply the friction surface restorer to the friction surface of the driving disc for one or two revolutions of the disc as shown in Fig. 28.

(10) De-energize the drive magnet and, with the orange stick, apply a drop of water in the gap between driving and driven discs. Energize the drive magnet and rotate the switch one or two revolutions as covered in (9) to insure that the driving surfaces of both discs are thoroughly moistened. Again de-energize the drive magnet and apply another drop of water in the disc gap. Leave the switch out of service till the water has evaporated.

(11) Rotate the sequence switch as covered in 3.005 and check for slip from time to time as covered in (1).

(12) Do not leave the position while the drive magnet is energized because, if the sequence switch slips or stops, immediate steps should be taken to eliminate the trouble so as to prevent smooth spots from being worn in the driven disc.

(13) If, after revolving several minutes, the switch fails to develop sufficient pull for prompt operation or has a tendency to falter or hesitate in any position, repeat the cleaning, grinding, and rusting operations as covered in (3), (4), (9), and (10).

(14) Recheck requirement 2.07 and, if necessary, readjust as covered in 3.07.

(15) Empty the water from the case of the friction surface restorer when its use is no longer required.

(16) Discard both the KS-2423 cloth and the emulsion solution used in (4) and (13) after their use on drive discs of 30 switches. See 3.007.

3.12 *A Cam-Roller Pressure* (Reqt 2.12)

(1) If the A cam-roller pressure is not within the specified limits, apply the 215 spring adjuster to the A cam-roller spring as shown in Fig. 29 and retension the roller spring to meet the readjust pressure limits.

3.13 *Contact-Spring Pressure* (Reqt 2.13)

(1) Before adjusting the contact-spring pressure on a split contact spring, make sure that both prongs of the spring leave a cam cutting approximately simultaneously when the sequence switch is rotated slowly by hand. Correct any misalignment by adjusting the

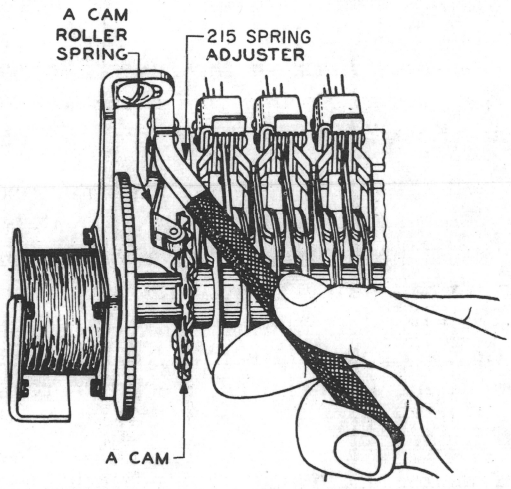

Fig. 29 – Method of Adjusting A Cam Roller Spring

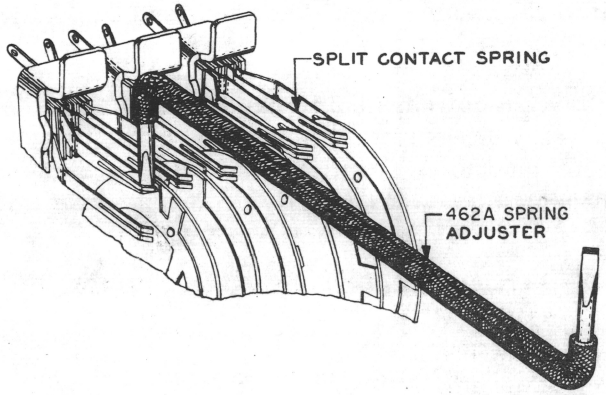

Fig. 30 – Method of Adjusting Prongs of Split Contact Springs

tips of the contact spring with the 462A spring adjuster as shown in Fig. 30. Adjust the prongs so that the angle at which the tips of the springs make contact with the cam is approximately 45 degrees. The slots in the adjuster are at an angle of 45 degrees to the cam when the handle of the adjuster is parallel to the cam. In adjusting an inner prong, move the spring away from the cam to place the spring adjuster on the inner prong.

(2) If the requirement is not met because of unequal pressure of the prongs, adjust the individual prongs as required with the 462A spring adjuster or with the R-2142 adjuster as covered in (3). Take care to apply the 462A spring adjuster at least 1/8 inch in front of

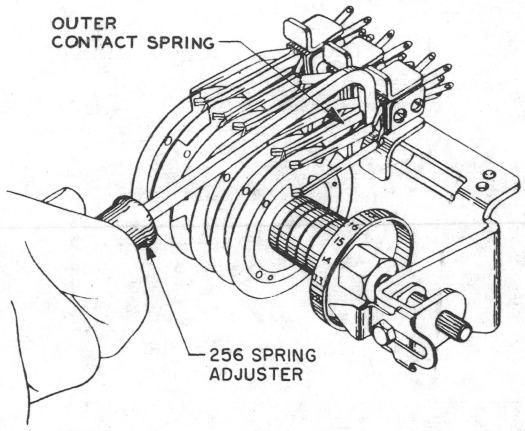

Fig. 31 – Method of Adjusting Outer Contact Springs

the base of the slot because of the danger of breaking the prongs. If the requirement is not met because of a twist in the spring, apply the 256 spring adjuster close to the point where the spring leaves the clamping plates and insulators as shown in Fig. 31 and adjust as required. On an inner spring, apply the 235 spring adjuster near the point where the spring leaves the clamping plates and insulators as shown in Fig. 32. Make sure that requirement 2.17 is met.

(3) To use the R-2142 adjuster for equalizing the pressure of the two prongs, place the tapered offset portion of the tool between the two prongs of the spring so that the offset portion of the tool is about 1/4 inch in front of the base of the slot. Apply a rotary motion to the handle of the tool in the direction necessary to equalize the pressures.

(4) If the contact spring pressure is not within the specified limits, readjust the springs as follows. Rotate the cam-shaft assembly until the spring or springs at fault rest on the metal part of the cam.

(5) Readjust the outer springs with the 256 spring adjuster applied as shown in Fig. 31 and the inner springs with the 235 spring adjuster applied as shown in Fig. 32. Adjust close to the point where the spring leaves the clamping plates and insulators.

(6) In readjusting springs, take care not to alter the effective length of the spring or to alter the angle at which the spring meets the cam sufficiently to change the relative posi-

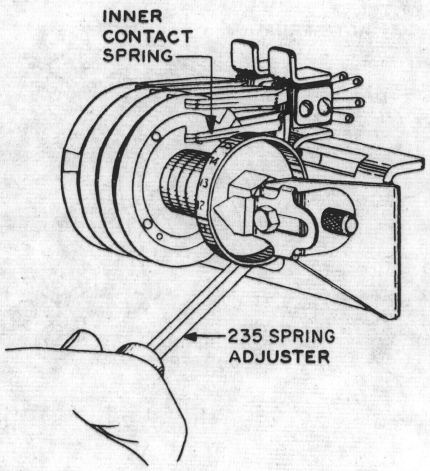

Fig. 32 – Method of Adjusting Inner Contact Springs

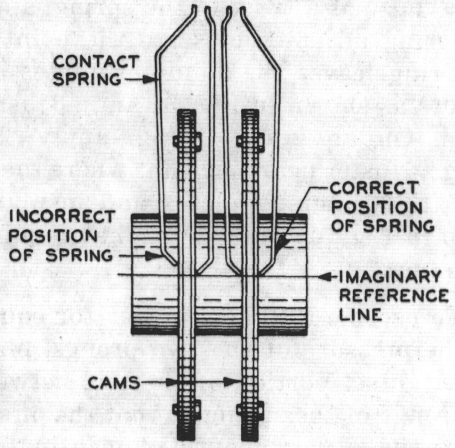

Fig. 33 – Relative Position of the Contacting Edge of the Spring With Respect to the Associated Cam

tion of the contacting edge of the spring with respect to the associated cam. See Fig. 33.

3.14 ***Parallelism of Contact Portion of Contact Spring With Face of Cams (nonsplit springs only)*** (Reqt 2.14)

(1) Readjust outer contact springs for parallelism by means of the 256 spring adjuster and inner contact springs by means of the 235 spring adjuster. Apply these adjusters as shown in Fig. 31 and 32, respectively, using a slight twisting motion. Take care not to distort the springs. Recheck requirement 2.13.

3.15 ***Clearance Between Adjacent Contact Springs and Between the Springs and Framework*** (Reqt 2.15)

3.16 ***Clearance Between the Inner Surface of the Contact Springs and the Metal Parts of Cams*** (Reqt 2.16)

(1) To readjust the springs for their proper clearance, it may be necessary to shift the spring assembly. To do this, loosen the spring assembly mounting screw with the 4-inch E screwdriver, shift the assembly as required, and then retighten the screw. After the spring assembly has been shifted, check that requirement 2.13 is met.

(2) If necessary to adjust an individual spring to obtain the proper clearance between adjacent parts, this may be done by means of the 235 and 256 spring adjusters as covered in 3.13, making sure that requirement 2.13 is met.

(3) If requirement 2.16 cannot be met due to a worn spring, replace the spring tip, except on the A spring, as covered in Section 030-801-812.

3.17 ***Vertical Location of Contact Springs*** (Reqt 2.17)

(1) If these requirements are not met, shift the individual springs at fault as follows. Loosen the spring-assembly mounting screw with the 4-inch E screwdriver and slide the spring assembly toward the magnet end of the sequence switch to gain access to the assembly clamping screws. Slightly loosen these screws with the 206 and 207 offset screwdrivers. If the assembly cannot be shifted far enough to the left to allow the 206 and 207 screwdrivers to engage the slots of the assembly clamping screws, it will be necessary to remove the spring-assembly mounting screw or the screw and washer and lift the assembly until the screwdrivers can be engaged in the slots of the assembly clamping screws.

(2) Move the spring in the assembly as required with the P-long-nose pliers and securely tighten the assembly clamping screws and the spring-assembly mounting screw. Check the spring to insure that the adjustment

has not been disturbed during the tightening operation and also that requirements 2.13, 2.15, and 2.16 are met.

(3) It may be necessary in some instances where vertical eccentricity is encountered when the sequence switch is rotated to replace the cam shaft as covered in Section 030-801-801.

3.18 ***A Spring Clearance*** (Reqt 2.18)

(1) If this requirement is not met because of wear of the A spring or A cam, replace the A cam or the A cam roller and spring assembly as covered in Section 030-801-801. It is permissible to change the length of the A spring by readjusting the spring with the 256 spring adjuster at the bend of the spring near the clamping plate, taking care that requirements 2.13, 2.15, 2.17, and 2.19 are met.

3.19 ***Centering of Contact Springs on Cams (18-position sequence switch only)***

3.20 ***Special Spring Adjustment*** (Reqt 2.20)

3.21 ***B Spring Clearance (only 20-position sequence switches not having A cams)*** (Reqt 2.21)

(1) Before adjusting to meet these requirements, determine to which of the following conditions the failure to meet these requirements is due:

(a) Misalignment of the prongs on split springs.

(b) Shifting of contact springs in assembly.

(c) Worn springs or A cam.

(d) Improper location of the cams including the A cam.

(e) Improper position of the A cam roller spring.

(2) ***Misalignment of Split Springs:*** If the prongs on split springs are not in adjustment, readjust them as covered in 3.13(1).

(3) ***Shifting of Contact Springs in Assembly:*** On earlier spring assemblies, it may be possible to shift the individual springs sufficiently to meet the requirements. To do this, loosen the spring assembly clamping screws as covered in 3.17(1) and shift the prongs forward or backward as required. Securely tighten the clamping screws and make sure that requirements 2.13, 2.15, and 2.16 are met. If it is not possible to shift the individual springs, proceed as covered in (4), (5), or (6).

(4) ***Worn Springs:*** If the requirements are not met because of a worn spring, replace the spring tip, except on an A spring, as covered in Section 030-801-812. If more than four tips of one spring assembly require replacement, it may be advisable to replace the complete spring assembly as covered in Section 030-801-801.

(5) ***Method of Changing Length of Spring:*** Where the spring has an offset in front of the clamping plates and insulators, increase or decrease the length of the spring by using a 235 spring adjuster (for inner springs) or a 256 spring adjuster (for outer springs) on the spring back of the rear offset and placing another 235 or 256 spring adjuster in front of the offset as shown in Fig. 34 and adjusting the offset in the spring. Take care that the angle of the spring tip is not changed from 45 degrees with respect to the cam surface. Make sure that the spring is not bowed and that requirements 2.13 through 2.16 are met.

(6) ***Relocation of Cams:*** Where the springs cannot be adjusted as covered in (3) or (5) to meet the requirement (particularly where the spring has no offset), shift the cam.

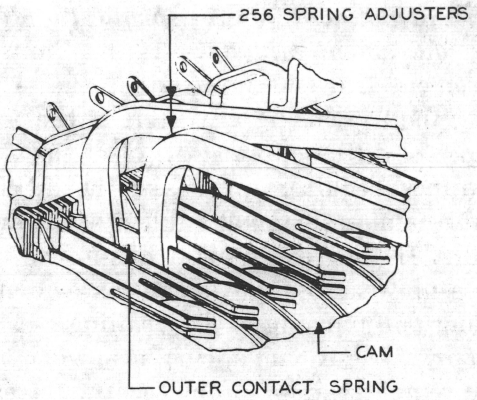

Fig. 34 – Method of Changing Length of Outer Sequence Switch Springs Using Two 256 Spring Adjusters

To do this, turn the cam-shaft assembly so that the cam reference hole is directly above the shaft, hold the cams on both sides of the cam under adjustment, and insert the projecting lug at the end of the driving rod of the 354 cam-locating tool inside of this reference hole. By means of the sliding hammer, tap the cam in a forward or backward direction as desired. Hold the cams and the tool as shown in Fig. 35. In some cases it may be necessary to loosen the cam clamping nut very slightly with the 236 wrench while holding the index wheel with the 203 index wheel holder as shown in Fig. 36.

(7) If the cam has been shifted, make sure that the other springs associated with it meet their position requirements and if necessary adjust them as covered in (4).

(8) ***Where Requirements Are Not Met on a Large Number of Springs:*** If the requirements are not met on a large number of springs of the switch, adjust the length of the A cam roller with the 215 spring adjuster by applying the adjuster just back of the roller. Grip the adjuster firmly so that the adjusting will be done as near the roller as possible. Make sure that requirements 2.12 and 2.19 are met.

(9) If the requirements cannot be met by adjusting the springs or the cam or where the wear of the cam or spring assembly is excessive, replace the cam or spring assembly at fault as covered in Section 030-801-801.

(10) ***Adjustment of A Spring to Meet Requirement 2.19(d):*** If the limits of requirement 2.18 permit, adjust the A spring using the 235 spring adjuster. If the A spring cannot be adjusted and still meet the A spring clearance requirement, make the adjustment on the cam or spring at fault other than the A spring. If the requirement cannot be met because of wear on the A cam as evidenced by pitting and burning of the trailing edge of the cam or, if the A cam spring is so worn that the requirement cannot be met without readjusting a large number of springs of the other cams, replace the A cam or A cam roller spring assembly as covered in Section 030-801-801.

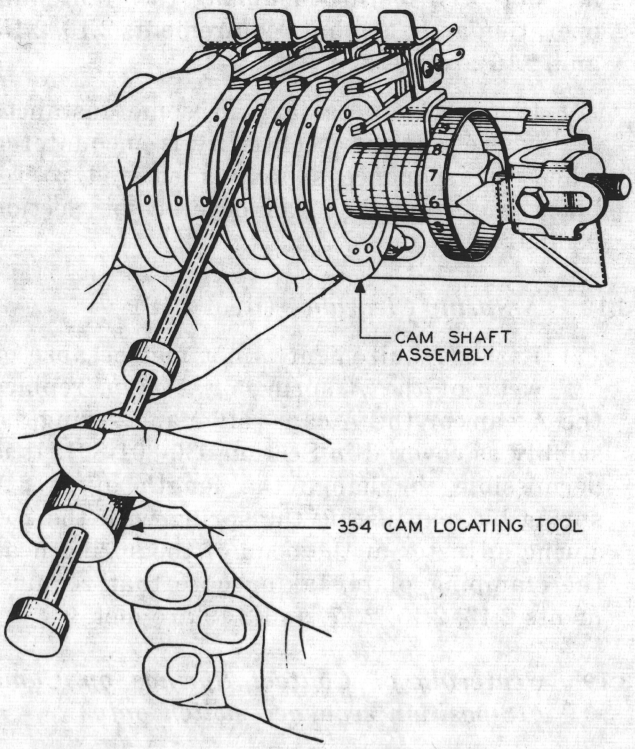

Fig. 35 – Method of Locating Cams

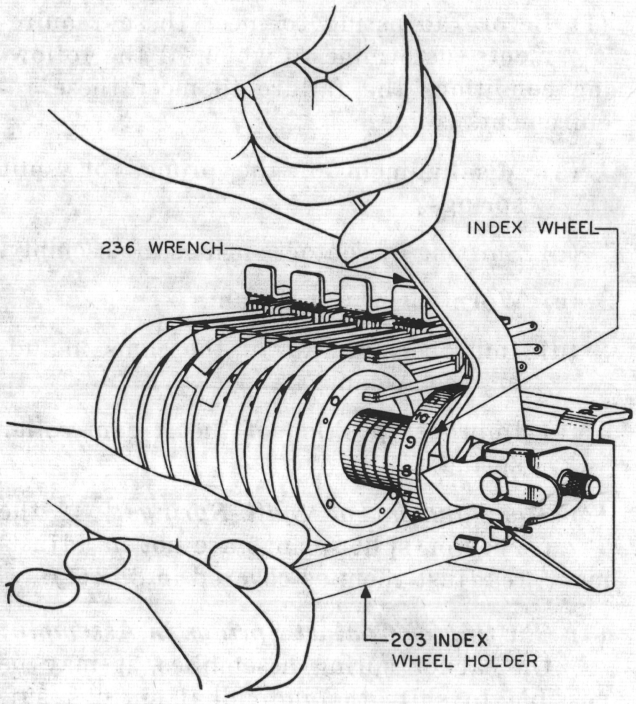

Fig. 36 – Method of Loosening the Cam Clamping Nut

(11) Do not shorten springs by crimping to meet special sequence requirements unless crimping is specified on the circuit requirement table or circuit drawing. If crimping is specified, the spring may be shortened either by crimping or by replacing the spring tip as covered in Section 030-801-812.

3.22 ***Condition of Spider Springs*** (Reqt 2.22)

3.23 ***Clearance Between Mounting Screws and Right-Hand End of the Slots in Sequence Switch Frame*** (Reqt 2.23)

No procedure.

REASONS FOR REISSUE

1. To revise the information covering methods of identifying springs equipped with No. 1 contact metal tips (1.10).
2. To revise the List of Tools, Gauges, and Materials (3.001).
3. To add information covering preparation of emulsion solution (3.007).
4. To revise the procedures covering drive pull (3.11).